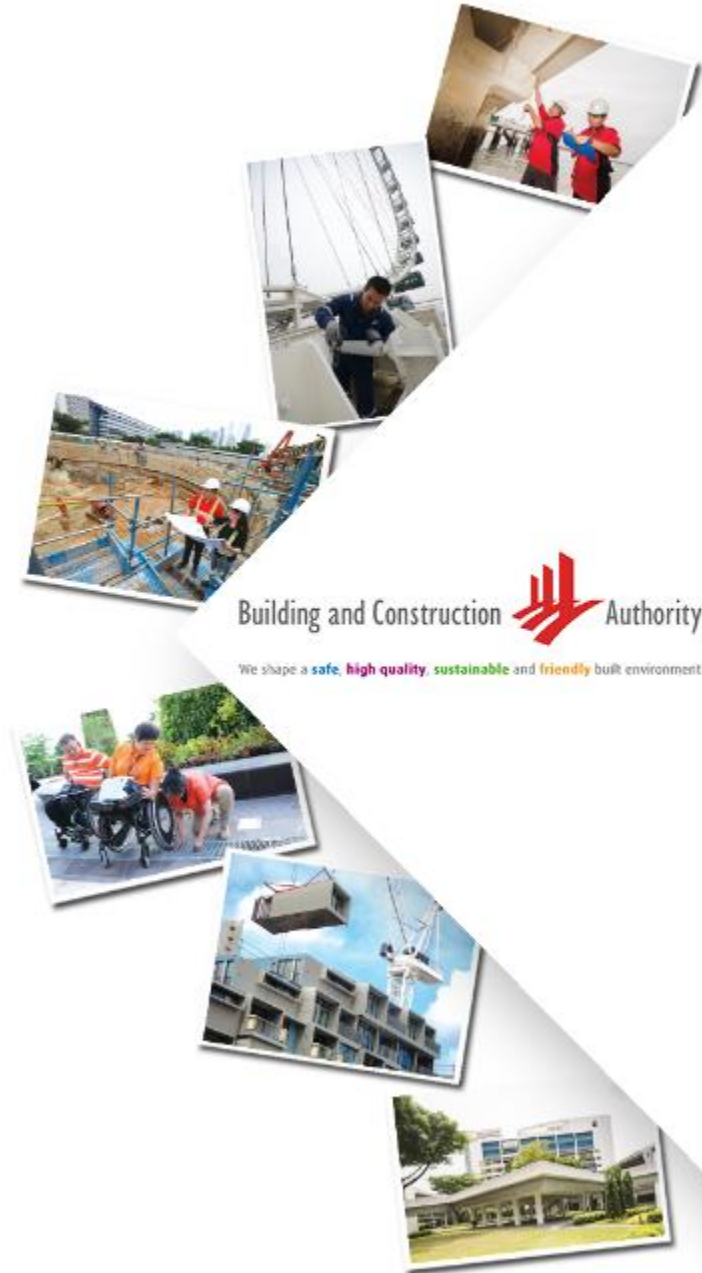


User Manual of VERIFY

ES/BERII



Objective of document

- The document serves as the user manual for the VERIFY tool, used for GM/SLE project verification process
- The tool URL is <https://sleb.sg/Building/GreenmarkVerification>

Basic Input - Building(s) Information

Building(s) Information

Building Name

XYZ

Reference No

GM 0000/0/2020

Address

200 Braddell Rd Singapore 579700

Green Mark Standard

Green Mark for Non-residential Buildings (Ver:

Key in Building Name/Project Name

Key in Green Mark project reference number

Fill in all the addresses if there are multiple buildings

Key in respective Green Mark version/standard

Summary of Inputs

S/N	Operation parameters	Reference Model	Actual Building
1	Building Type	Same as actual building	Select from the drop-down list
2	GFA	Same as actual building	Final – Verification inputs (building info sheet)
3	Percentage of Air-Conditioned Area	Same as actual building	Final – Verification inputs (building info sheet)
4	ETTV (W/m ²)	50	usually the same as Design (EM APPENDIX D)
5	Operation Schedule	Same as actual building	Actual Building (EM APPENDIX D)
6	Receptacle Load Density (Operation) (W/m ²)	Same as actual building	Final – Verification inputs (building info sheet)
7	Lighting Power Density (Operation) (W/m ²)	Calculated baseline based on the GM standards	Final – Verification inputs (building info sheet)
8	Chiller Plant Energy Consumption (kWh/year)	To be calculated	Actual Building Consumption (EM APPENDIX D)
9	Chiller Plant Efficiency (kW/RT) (Operation) – OSE Report	Calculated baseline based on the GM standards	Final – Verification inputs (building info sheet and OSE report)
10	Air Distribution System Energy Consumption	To be calculated	Actual Building Consumption (EM APPENDIX D)
11	Air Distribution System Efficiency (Operation)	Calculated baseline based on the GM standards	Final – Verification inputs (building info sheet)
12	Mechanical Ventilation Energy Consumption (kWh/year)	To be calculated	Actual Building Consumption (EM APPENDIX D)
13	Mechanical Fan Efficiency (W/CMH)	Calculated baseline based on the GM standards	Final – Verification inputs (building info sheet)
14	Hot Water System Energy Consumption (kWh/year)	To be calculated	Actual Building Consumption (EM APPENDIX D)
15	Hot Water System COP	Calculated baseline based on the GM standards	Actual Building Consumption (EM APPENDIX D)
16	Lift Energy Consumption (kWh/year)	To be calculated	Actual Building Consumption (EM APPENDIX D)
17	Lift with Regenerative Features (Yes/No)	No	As-built Information (EM APPENDIX D)
18	Escalator Energy Consumption (kWh/year)	To be calculated	Actual Building Consumption (EM APPENDIX D)
19	Escalator with Sleep Mode Features (Yes/No)	No	As-built Information (EM APPENDIX D)
20	Renewable Energy Capacity (kWp)	To be calculated	Actual Building Consumption (EM APPENDIX D)
21	Other System Energy Consumption- e.g domestic water pumps and etc....	Same as actual building consumption, typically no savings in EM	Actual Building Consumption (EM APPENDIX D)

Input – Building Operation

Notes:

1. Please provide all the required information under the “Actual Building” column.
2. You may choose to edit some of the parameters under the “Reference Model” column based on your applied Green Mark version/standard.
3. For mixed-use buildings, please add each type of building separately using the “Additional Building” button.

Fill all the required information under the “Actual Building” column

Building 1	Reference Model	Actual Building
Building Type	Office Building	OFFICE BUIL... <input type="text"/>
GFA (m2)	10000	10000
Percentage of Air-Conditioned Area (%)	80	80
ETTV (W/m2)	50	35
Es	Reference model's value that can be edited	1000
Es	calculated	YES <input type="text"/>
Renewable Energy Capacity (kWp)	0	0
Other System Energy Consumption (kWh/year)	1000	1000

Additional Building

Reference model's value that can be edited

In case of mixed-use buildings, please add each type of building separately using the “Additional Building” button.

Input – Building Operation

Building 1

	Reference Model	Actual Building
Building Type	Office Building	OFFICE BUIL... ▾
GFA (m2)	10000	10000
Percentage of Air-Conditioned Area (%)	80	80
ETTV (W/m2)	50	35
Operation Schedule (hours/week)	55	55
Receptacle Load Density (W/m2)	5	5
Lighting Power Density (W/m2)	12	5

Gross Floor Area excluding car park area

Average ETTV of the building envelope

Actual building operation hours per week

Average receptacle power density (operation) of the building

Average lighting power density (operation) of the building

Input – Building Operation

Chiller Plant Energy Consumption (kWh/year)	To be calculated	200000
Chiller Plant Efficiency (kW/RT)	0.75	0.5
Air Distribution System Energy Consumption (kWh/year)	To be calculated	50000
Air Distribution System Efficiency (kW/RT)	0.25	0.125
Mechanical Ventilation Energy Consumption (kWh/year)	To be calculated	50000
Mechanical Fan Efficiency (W/CMH)	0.3	0.2

Actual annual energy consumption of chiller plant including chillers, water pumps and cooling towers (for water-cooled plants)

Measured average efficiency (operation) of chiller plant, including chillers, water pumps and cooling towers (for water-cooled plants)

Actual annual energy consumption of air distribution system

Measured average efficiency (operation) of air distribution system

Annual energy consumption of non-air-conditioning mechanical ventilation system

Average/weighted efficiency (operation) of mechanical ventilation system

Input – Building Operation

Hot Water System Energy Consumption (kWh/year)	To be calculated	0
Hot Water System COP	3.2	3.2
Lift Energy Consumption (kWh/year)	To be calculated	1000
Lift with Regenerative Features	No	YES <input type="checkbox"/>
Escalator Energy Consumption (kWh/year)	To be calculated	1000
Escalator with Sleep Mode Features	No	YES <input type="checkbox"/>
Renewable Energy Capacity (kWp)	0	0
Other System Energy Consumption (kWh/year)	1000	1000

Annual energy consumption of hot water system.
Key in “0” if not applicable.

COP of hot water system.
Leave this field unchanged if there is no hot water system in the building.

Annual energy consumption of lifts.
Key in “0” if not applicable.

Annual energy consumption of Escalators.
Key in “0” if not applicable.

Total installed solar PV system capacity.
Leave this field as “0” if not installed.

Annual energy consumption of other energy end uses, including domestic water systems, unitary AC, etc.

This value should be the same as that of the actual building if there is no energy efficiency measures applied to these other systems.

Click here to run the calculator



▶ Run Calculating

Important Note:

The tool is only applicable to typical building designs and limited building typologies. If you have any doubt on the results calculated by our tool, you shall use an alternative tool or method.

Building(s) Information

Building Name	SSPd
Reference No	GM2528/10/2016
Address	Business park
Green Mark Standard	GM V 4.1

Building 1	Reference Model	Actual Building
Building Type	Office Building	OFFICE BUIL... ▾
GFA (m2)	25564	25564
Percentage of Air-Conditioned Area (%)	89.4	89.4
ETTV (W/m2)	50	34
Operation Schedule (hours/week)	70	70
Receptacle Load Density (W/m2)	18.91	18.91
Lighting Power Density (W/m2)	15	8.23
Chiller Plant Energy Consumption (kWh/year)	To be calculated	869258
Chiller Plant Efficiency (kW/RT)	0.75	0.602
Air Distribution System Energy Consumption (kWh/year)	To be calculated	414391

Building Benchmark

Building(s) Information

Building Name	SSPd
Reference No	GM2528/10/2016
Address	Business park
Green Mark Standard	GM V 4.1
Building Type	Office Building
Gloss Floor Area (m2)	25564

End Use	Reference Model Energy Consumption (kWh)	Actual Building Energy Consumption (kWh)	Energy Saving (%)
ACMV	1989195	1283649	35.5%
Lighting	1395794	765825	45.1%
Receptacle Equipment	1759631	1759631	0.0%
Mechanical Ventilation	405382	221995	45.2%
Lifts & Escalators	27540	22583	18.0%
Hot Water System	0	0	-
Other System	69062	41677	39.7%
Total Building Energy Consumption	5646605	4095361	27.5%

Output

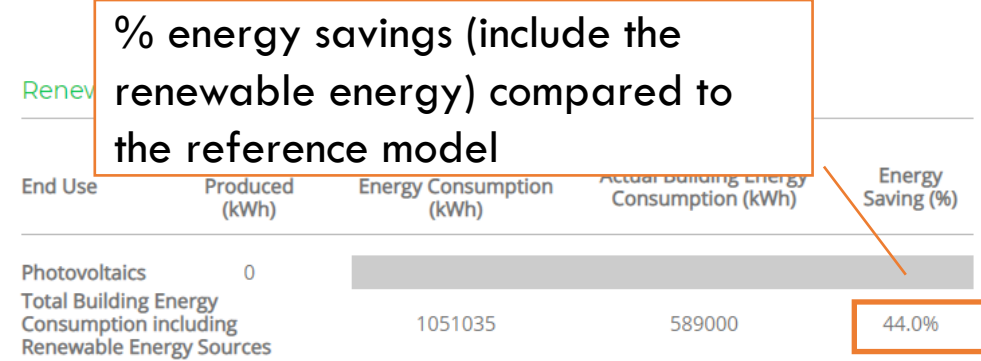
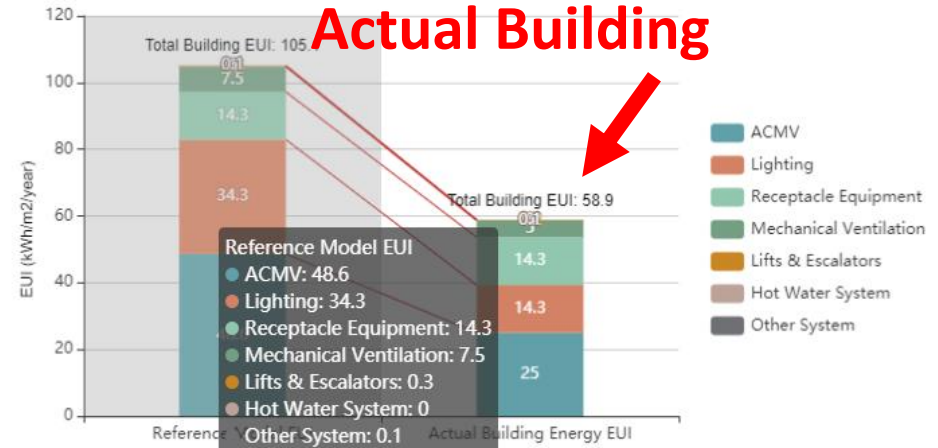
Building Benchmark

Building(s) Information

Building Name	Building Name
Reference No	Ref No
Address	Address
Green Mark Standard	GM Standard
Building Type	Office Building
Gloss Floor Area (m2)	10000

End Use	Reference Model Energy Consumption (kWh)	Actual Building Energy Consumption (kWh)	Energy Saving (%)
ACMV	486187	250000	48.6%
Lighting	343200	143000	58.3%
Receptacle Equipment	143000	143000	0.0%
Mechanical Ventilation	75000	50000	33.3%
Lifts & Escalators	2648	2000	24.5%
Hot Water System	0	0	-
Other System	1000	1000	0.0%
Total Building Energy Consumption	1051035	589000	44.0%

AI Generated EUI of Actual Building



% energy savings (include the renewable energy) compared to the reference model

% energy savings (exclude the renewable energy) compared to the reference model

Special cases with extra high receptacle load > 25% of reference

- Building with high receptable load, receptable load is cap at 25% of the reference consumption.
- Use the measures receptable load density W/sqm and key into the AI.
- Check if the receptable load is more than 25% consumption of the reference energy consumption.
- Derive the cap value of receptable load and convert back to W/sqm
- New receptacle load density = (Total consumption without receptable load / 75%) * 25% = receptacle load / operating hours / year = W/sqm (use this for the input to Actual building)

What to look out?

- Different type of air-conditioning system e.g use of chilled water plant and DX - how do we input to the model?
- Ans: There are two ways to key in data if there are multiple types of ACMV system:
 1. **Grouping chiller plants and unitary systems** – key in the total energy consumption of chiller plant and unitary system under “Chiller Plant Energy Consumption (kWh/year)”; key in the weighted average efficiency (based on cooling loads) of the above systems under “Chiller Plant Efficiency (kW/RT)” for both reference model and actual building.
 2. **Separating chiller plants and unitary systems** – key in the energy consumption and efficiency of chiller plant under “Chiller Plant Energy Consumption (kWh/year)” and “Chiller Plant Efficiency (kW/RT)” respectively; include the reference and the actual unitary energy consumption in “Other System Energy Consumption (kWh/year)”. This method needs the user to self-justify the energy savings of the unitary system.
- Building do not have hot water, escalators and etc, how do we key in the AI calculator.
- Ans: We may put “0” for those not applicable energy end use, e.g. hot water, escalators and so on. Please refer to the user manual for the details.

Thank you!